No. 178

solplan review

the independent journal of energy conservation, building science & construction practice

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Attic Ventilation

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EXPIRY: 06/26/16
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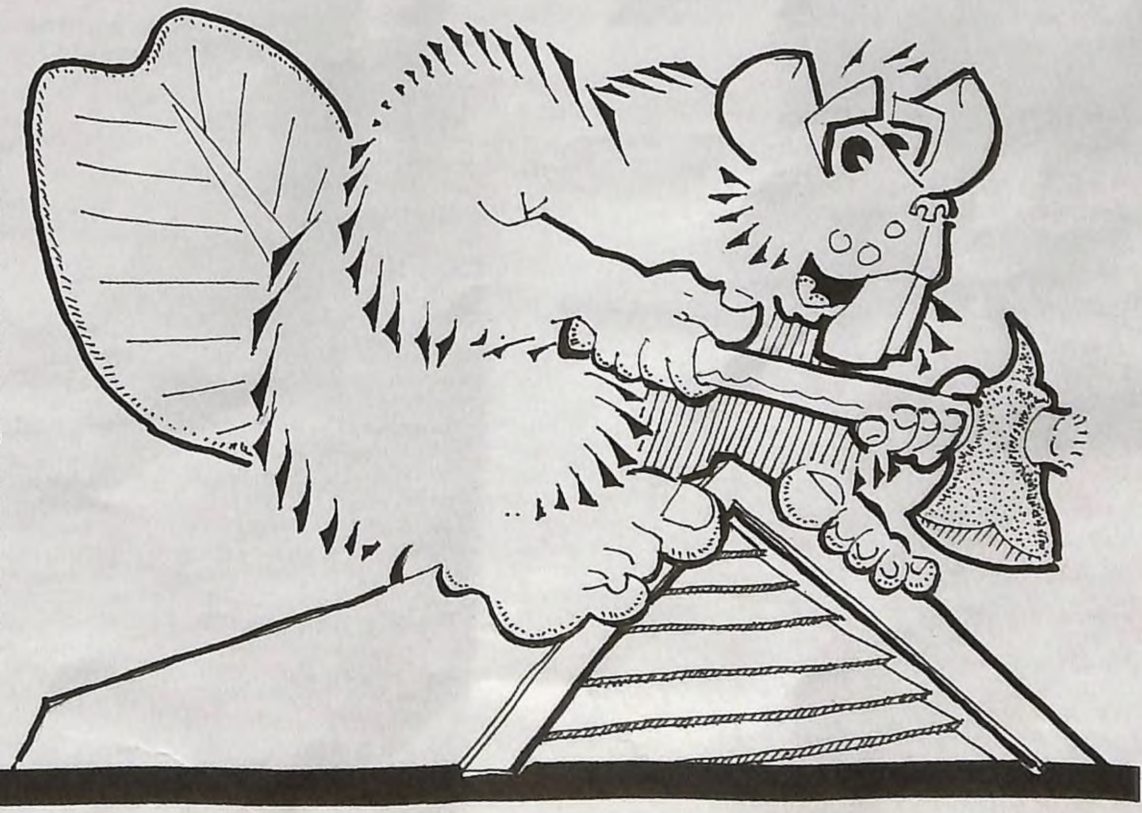
Publication Mail Agreement No. 40013363



From The Editor . . .

Marketing has reached a high level of sophistication today. A massive industry exists to persuade us to buy something, take some action, and even what to think. The whole process fascinates so many of us that now there are a number of media shows that have attracted big audiences that discuss just how we are poked, prodded, convinced and otherwise manipulated.

Despite a relatively high level of media (and marketing) savvy, many of us can still be drawn in by silver-tongued pitches. It seems that we can still be drawn in by what is evidently too good to be true.

In the realm of energy efficiency, there is a genuine desire today to achieve high performance as we move to making net zero energy buildings the new norm in the future. It's an achievable goal, but it will require some rethinking of how we build. But there's always the hope that we can achieve it simply using a magic bullet.

Along come the marketers, like the snake oil con-men of another generation, who come up with impressive sales pitches. They look at a product, and with sleight of hand, selective editing of reports about their products, and a heavy reliance on anecdotal comments, show how their product is the new indispensable tonic. It helps if their audience doesn't fully understand the basic principles involved, or is not able to discern the marketing spin. The pitch is usually carefully prepared so that we only hear what we want to hear. It's the power of wishful thinking.

This is especially the case with radiant insulation products. Radiant heat flows are more complex to evaluate and describe than conduction or convection, although they may be more important.. With radiant heat flows, it is not only the temperature difference that matters, but also the nature of surrounding surfaces and their geometry.

Many materials can have an influence on radiant heat flows. Slick packaging and an interesting story line can be woven around even regular materials to imply that with the special additive or coating, the material now has acquired a special property worth the high mark-up applied, as it will deliver incredible results. Many, including professionals who should know better, are still getting sucked in by these enticing promises.

This came to mind as I've come across yet another legal action in the US against a marketer of radiant insulation products. The company was fined a record $350,000 penalty for making deceptive and unsubstantiated claims about their products' insulation capabilities. They are selling liquid coatings and foil radiant barrier products, with false advertising claims such as "R-100 paint," "This . . . reflective coating will reduce wall and roof temperatures by 50-95 degrees . . ." and "Saves 40 to 60% on your energy bills."

The court order permanently prohibits them from making a claim about a product's insulation value or energy savings unless it is true, not misleading, and based on competent and reliable scientific evidence.

In the US, the Federal Trade Commission has the R-value Rule that requires insulation manufacturers, professional installers, new home sellers, and retailers to provide R-value information based on the results of standard tests. Although the standard test protocol used to measure R-values may not be ideal, and there is much debate about that now, they are still the best yardsticks we have by which to compare products.

Richard Kadulski,
Editor

solplan review
the independent journal of energy conservation, building science & construction practice

Editor-Publisher: Richard Kadulski
Illustrations: Terry Lyster
Contributors: Rob Dumont, Janet Ansell,
ISSN: 0828-6574
Date of Issue: April 2015
SOLPLAN REVIEW is published 6 times per year by:
the drawing-room graphic services ltd.
PO Box 86627, North Vancouver, BC V7L 4L2
Tel: 604-689-1841 Fax: 604-733-1842
e-mail: solplan@shaw.ca
Street address:
#204 - 1037 West Broadway
Vancouver, BC V6H 1E3
Publications Mail Agreement No. 40013363
Postage paid in Vancouver, BC.

Return undeliverable Canadian addresses to
PO Box 86627, North Vancouver, BC V7L 4L2
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Attic Ventilation

Building codes require attics to be ventilated. The intent is to remove moisture that escapes from the building's interior into the attic. Does attic ventilation really work? How much is really needed? Does the ventilation need differ for different climatic conditions or house styles?

Attic ventilation is firmly established as a critical element in roof construction. Lack of ventilation is routinely blamed for a variety of problems and failures. It is claimed that in addition to moisture control, attic ventilation benefits summer cooling of the attic air to reduce cooling loads, minimizes ice dams in cold climates, and extends the service life of roof materials by reducing surface temperatures.

The connection between the movement of heat and moisture and ventilation of attics of wood-framed sloped roofs has been studied since the 1930's and has influenced building codes that spell out prescriptive requirements for the ventilation of wood-framed roofs. The original purpose of attic ventilation seems to be to minimize condensation in attics.

Most Canadian research into attic moisture problems has identified that the leading cause of attic problems and high sheathing moisture content is generally the transfer of moist indoor air into the attic space due to high indoor humidity.

The intent of attic ventilation is to reduce the potential for problems by diluting interior air moisture sources and, in theory, to provide some drying of moisture in the attic. In cold climates, it is intended to maintain a cold roof and minimize ice dams created by melting snow and to vent moisture that may move out of the conditioned interior space by air leakage through imperfections in the air barrier, mechanical ducts, and other ceiling penetrations. However, the level of drying is dependent on the temperature and moisture capacity of the attic air and heat supplied to the attic from the conditioned space or from the sun heating the roof surface. A debate among researchers continues about the actual benefit of the mandatory requirements for venting all types of roof assemblies.

Ventilation and Climate

Computer simulations show that in extreme climatic zones in Canada, such as the Prairies, attic ventilation may be prudent, and the code specification of a vent area of 1:300 is generally satisfactory. However, in more moderate climates, such as the west Coast,,the same simulations suggest that the same code requirement tends to over ventilate attics, actually contributing to higher moisture levels.

Despite steady attention to the subject over the years, there is evidence that buildings seemingly built to code, in cool marine climates, are experiencing high incidences of moisture problems leading to mould growth in roof attics. Problems related to mould growth in attics are currently showing up in recently built wood-framed buildings in coastal British Columbia.

This problem is not unique to the coastal climate and West Coast construction practices. Surveys are showing that as many as 60 to 80% of single-family houses in the Gothenburg region of Sweden, also a cool marine climate, are showing significant mould growth. The frequency of reported attic moisture problems has increased as insulation levels in attics have increased to address energy efficiency goals.

In Belgium, problems with condensation and mould in attics indicated that ventilation was a risky approach in milder wet climates, and that it was better to provide an airtight ceiling assembly. This led to changes in design and construction practices – ceilings are generally cathedral ceilings and the attics have become living spaces.

Sources of moisture in attics include air leakage, roof leaks, wind driven snow or rain, ice damming, and the outdoor air ventilating the attic space. Canadian building codes include measures to minimize the entry of interior moisture into attics from air leakage and vapour diffusion. They also have prescribed requirements on the size and location of vent openings in attics to promote ventilation.

In spite of the code requirements, continuing observations have noted that an unusually large portion of wood-framed buildings constructed in coastal climates exhibited mould growth on the

roof sheathing of ventilated attics. The amount of mould growth on the roof sheathing can range from small isolated areas to almost complete coverage. In some recently built buildings, the observed mould growth seemed to be concentrated near vent openings – in other words, at locations with the most ventilation. This is contrary to the common view that inadequate attic ventilation is a major cause of moisture collection and mould growth and that the solution to attic moisture problems is to increase attic ventilation.

There are several factors that can contribute to moisture issues in cool climates. The drying capacity of outdoor air during winter, especially in maritime climates, is low because of constant high outdoor humidity and the lack of sunshine that limits the drying benefits from solar exposure. In addition, because of higher insulation levels, reducing heat loss from the conditioned space, the exposed framing will be colder, so the moisture content of the wood (because of the absorption of ambient moisture) will be higher.

On a clear night, the night sky radiant cooling of the roof can result in temperatures on the roof that are lower than ambient air temperatures. The consequence of this is that relative humidity increases, and moisture absorption by the framing lumber increases. With less opportunity for drying, moisture content can reach levels well above 20% - levels that will support mould growth. In addition, even small amounts of moisture movement from indoors to the attic, driven by stack action, can contribute to problems.

Attic Ventilation and Moisture Research Study

To assess the issue of mould in attics, the Homeowner Protection Office undertook The Attic Ventilation and Moisture Research Study. The work was done by Morrison Hershfield.

> There is a growing body of anecdotal information of recently constructed buildings indicating that:
>
> - Attic ventilation may not be helpful in controlling moisture in, and mould growth on, the wood sheathing and framing in well-insulated attics located in cool maritime climates.
> - In some cases, attic ventilation may actually increase moisture in, and mould growth on, the wood sheathing and framing in well-insulated attics in cool maritime climates.

The first phase of the study looked at a recently built low-rise multiple family building. It verified that the construction met code requirements for attic ventilation, and that the air leakage areas between the indoor space and the attic space was within the norms of good construction practice. They also monitored indoor and outdoor conditions, and measured the average attic ventilation levels and air leakage from the indoors to the attic using tracer gases. There was also a roof over the outdoor mailboxes which was monitored as a control structure, as it is exposed to ambient conditions on all surfaces.

It was observed that in all the tested units, all of which had mould growth in the attics, the ceiling airtightness and attic venting area was consistent with code requirements and good building practice. The monitored units did not exhibit excessive indoor humidity. However, in all roofs, the moisture content of the attic sheathing reached levels that would support mould growth. Significant wetting occurred at times with clear and cold nights, which were followed by sunny days. The study suggests that higher ventilation rates will not significantly decrease the moisture levels in the attic and will not alleviate the occurrence of staining.

The tracer gas testing showed that, in spite of good ceiling airtightness, which was confirmed by testing, the air leaking out from the living space into the attic was a significant fraction of the attic air exchange. However, the air transfer from the attic into the living space was very small, so that any mould in the attic is not likely to be a significant source of biological contamination in the living space.

The second phase of the study focused on the factors that lead to moisture accumulation and mould growth in attics. The goal was to identify both design solutions and treatments that can minimize the potential for mould growth.

In two of the units, the attic venting areas were altered and monitoring continued for another heating season. Heat, air, and moisture simulation, calibrated to monitored data, was done to evaluate the impact of different levels of ceiling airtightness, indoor moisture levels, attic ventilation rates, sheathing thermal resistance, and insulation levels.

It was found that a dramatic reduction in insulation from current levels, back to levels before higher insulation requirements were introduced in the 1990s, could reduce the potential for mould growth. However, there is effectively no difference in the risk of mould growth between current insulation levels (R-30) and going to more than R-50.

Ventilation of the attic through the attic vents is a principal source of moisture in attics in marine climates even though it is also a necessary moisture removal mechanism. Modifications to the venting area and distribution do not appear to be a solution to avoid mould growth in cool marine climates. More ventilation will not solve attic moisture issues. The addition of a thin layer of insulation outside the sheathing can reduce the wetting potential of roof sheathings but requires more study before becoming an accepted solution on its own right.

Tracer gas testing carried out over two one-week periods (in December and in February), showed that attic air exchange rates were low when environmental driving forces, such as wind, for attic air movement are low.

While a variety of solutions were examined, the general result of the analysis suggests that there are two general ways of minimizing the potential for mould growth in ventilated attics:

1. Avoid using ventilated attics by selecting and designing assemblies that do not require ventilation.
2. Treat wood roof sheathing, as a minimum, with mouldicides and other products to increase the resistance of wood in ventilated attics to mould growth.

The first approach is generally limited to new construction and imposes changes and (usually) additional costs to current practice.

There are a number of products purporting to treat wood to resist mould growth. However, ongoing research is raising questions about the ability of some to provide long-term resistance to mould growth in ventilated attics and address any environmental concerns that some may have with using chemicals to make wood sheathings more mould resistant. There will likely be some trial and error that will occur in practice until there are fully accepted products and procedures for treating wood in attics to address mould growth.

Since some consumers may be adverse to chemically treated wood or the possible requirement of ongoing treatments, industry needs to take a hard look at design options to avoid attics that require ventilation. The most feasible solution for low-slope roofs is to insulate outboard of the roof structure with a conventional roof assembly. For a steep sloped roof assembly, the most feasible design alternative is an unvented roof assembly, which can also have other benefits like increased conditioned living space. ☼

Attic Ventilation and Moisture Research Study by Morrison Hershfield for the Homeowner Protection Office, a branch of BC Housing.

Is Attic Mould A New Phenomenon?

For mould growth to take place, you need the right conditions: temperatures able to support mould, food and moisture. At various times of the year all three are present in our home environments, as well as house structures. Minor occasional wetting and mould growth is almost inevitable in wood frame construction. There probably always has been, and will be, mould growth in home attics. In most cases, it is seasonal and when conditions change, moisture content drops, mould goes dormant and dies off – with little consequence.

Provided that the extent of the mould is not great, and only of short duration, it probably has little consequence. Anyone who has done any work on an older structure will have seen plenty of evidence of mould and moisture from the past. The current practice of pre-purchase property inspections is probably driving the concern about attic mould. All an inspector needs to do is stick his head into the attic, spot a little dark spot, and report the presence of mould in the attic to trigger major concerns.

It's all a matter of perspective: what is the extent of the mould, where, and how widespread is it.

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Framing: Part Of New Energy Efficient Equation

There is a push for new construction to be more energy efficient, right to net zero energy buildings. Increasingly more and more jurisdictions are adopting stricter energy codes in this direction. Europe is on target to mandate net zero design by 2020. California will require net zero energy design for new homes by 2020 and new commercial projects by 2030. Whether the goals are reached by 2020 or a bit later, this is the direction for the future. Both California and Europe are leaders in setting standards.

Achieving the high performance and desired net zero building standards will require reviewing and changing what and how we build today. In the case of older buildings, many are like leaky buckets – the air leakage adds to the energy needed to heat and cool, and contributes to structural deterioration as interior air leaking outward condenses and gets absorbed by structural materials. As that building stock is renovated, some of the new approaches will also need to be applied in a careful manner so as not to compromise older structures. However, codes generally focus only on new construction.

In conventional construction, the energy needed to heat and cool a building is used inefficiently as a consequence of "conventional" framing techniques. Before thinking about adding renewable energy sources to the building, to achieve a net-zero building, the energy demand must be minimized. There are many variables that can minimize energy needs, including building size, orientation, air leakage, and enclosure design.

Careful attention to mass and orientation of a building is one way to reduce energy consumption. However, beyond design, we need to consider the building envelope itself and how to efficiently design the structure to maximize the airtightness and insulation, while minimizing the framing factor.

Heat loss through the walls is measured in terms of thermal resistance (R) of a wall by taking into account the effects of all the different components of the wall assembly – not just the insulation. The U-factor is the inverse of the R-value and used to evaluate multiple heat flow paths through a whole assembly. U-values are the typical value used for windows, and are also analysis of larger buildings that use the National Energy Code for Buildings or ASHRAE 90.1 calculations.

In order to reduce the thermal conductance of the exterior walls, one can increase the depth of the wall cavity, use higher performance wall cavity insulation (higher R-value per inch), reduce the framing factor (the percentage of the total solid exterior wall area occupied by framing members), cover the outside of the building with continuous insulation, or a combination of these strategies.

When 2x4 framing was standard, the net difference between insulation and framing was small, and when the impact of the other materials in the assembly was considered, the overall effective R-value was similar to the nominal value of the insulation.

However, in conventional construction, framing accounts for about 23 percent of the wall surface area. When the R-value of wood (roughly R 1.15 per inch thickness) and its total area is compared to area and insulation value of the stud cavity (3.3 per inch for batt insulation up to about 6 per inch for 2-lb spray foam) one can see that the overall effective insulation value of the wall can be significantly different, especially with highly insulated walls.

By using advanced framing techniques, the framing factor can be brought down to about 16 percent, to improve the effective R-value.

Advanced framing details include spacing studs at 24 inches on center to increase cavity insulation space, more careful detailing at corners and wall intersections to reduce redundant framing, and eliminating double top plates.

Effective R-values

Required Effective R-value For Walls Above Grade			
Zone	DD°C	No HRV	HRV
4	< 3,000	2.78 *(15.78)*	2.78 *(15.78)*
5	3,000 to 3,999	3.08 *(17.48)*	2.97 *(16.86)*
6	4,000 to 4,999	3.08 *(17.48)*	2.97 *(16.86)*
7A	5,000 to 5,999	3.08 *(17.48)*	2.97 *(16.86)*
7B	6,000 to 6,999	3.85 *(21.86)*	3.08 *(17.48)*
8	> 7,000	3.85 *(21.86)*	3.08 *(17.48)*
Bracketed numbers are Imperial R-value equivalent			

The recent update to the National Building Code has caused considerable apprehension among builders and building officials. The construction industry is slow to change, and there's always fear of change. The new code changes require rethinking how we look at the construction assemblies we use. However, once builders figure out what works for them, it will be realized that the change is not as big as it appears at first.

The major change in the code is the requirement to use effective R-values for wall assemblies. In the past, the code requirement was for a "nominal" R-value. If the code required R-20, a notation on the plans that the wall was 2x6 and had R-20 insulation, it was deemed the wall had R-20 performance, and complied with the code. That is no longer acceptable under the new code requirements.

Typical softwood has an R-value of about 1.2 per inch, while a fibreglass batt is about 3.3 per inch. With typical framing practices, 23 per cent of the wall area is accounted for by the framing, so that only 77 per cent of the wall area is insulation. When a calculation is made taking into account the areas of the two areas, the total R-value is much less than that of the insulation alone – so effectively, the overall R-value of the entire wall is decreased.

Every component within a wall assembly, from studs and insulation to rain screen, exterior cladding, interior drywall and even the boundary layers of still air, must be added into the calculation of effective R-value.

The Code provides tables that provide insulation values for most materials commonly used in construction, and also tables that help with calculation of effective R-values for the whole assembly.

Most builders typically use three or four typical assembly types, depending on the exterior finishes they use. We've prepared this table showing the effective R-value for typical assemblies for each climate zone.

Certified Energy Advisors can provide advice and review typical details to come up with typical effective R-values for the most common assemblies. It can be a shortcut to start working with the new Code requirements.

Effective R-Value Tables

We've prepared these tables to show the effective R-value of typical wall assemblies in use today. A few of these include a rain screen – that airspace does contribute a small but for some assemblies a significant insulating value.

Values for these and other assemblies can be found in Table A-9.36.2.6.(1)A (minimum R-values to be made up by insulation, sheathing and other materials) & A.9.36.2.4.(1)D (thermal R-values of common building materials).

If you have an assembly that has a different cladding material, or different continuous layer of insulation or other material, you can change that value to determine the revised effective R-value.

As can be seen, it's possible to achieve very high performance assemblies even with 2x4 framing.

	RSI	R-value
2x6 @ 24" o/c; R-20 insul	2.45	
Interior air film	0.12	
1/2 " interior gyp board	0.08	
1/2" softwood plywood or 11 mm OSB	0.109	
Exterior cladding: stucco	0.02	
Exterior air film	0.03	
Effective R-value assembly total	**2.81**	**15.95**

	RSI	R-value
2x6 @ 16" o/c; R-20 insul	2.36	
Interior air film	0.12	
1/2 " interior gyp board	0.08	
1/2" softwood plywood or 11 mm OSB	0.109	
Rain screen cavity	0.15	
Exterior cladding: stucco	0.02	
Exterior air film	0.03	
Effective R-value assembly total	**2.87**	**16.29**

	RSI	R-value
2x6 @ 16" o/c; R-22 insul	2.55	
Interior air film	0.12	
1/2 " interior gyp board	0.08	
1/2" softwood plywood or 11 mm OSB	0.109	
Exterior cladding: stucco	0.02	
Exterior air film	0.03	
Effective R-value assembly total	**2.91**	**16.52**

	RSI	R-value
2x6 @ 16" o/c; R-24 insul	2.66	
Interior air film	0.12	
1/2 " interior gyp board	0.08	
1/2" softwood plywood or 11 mm OSB	0.109	
Exterior cladding: vinyl siding	0.11	
Exterior air film	0.03	
Effective R-value assembly total	**3.11**	**17.65**
R-24 batt insulation is a more dense semi-rigid batt that requires attention when being installed		

	RSI	R-value
2x4 @ 16" o/c; R-12 insul plus R-7.5 continuous exterior	2.81	
Interior air film	0.12	
1/2 " interior gyp board	0.08	
1/2" softwood plywood or 11 mm OSB	0.109	
Exterior cladding: stucco	0.02	
Exterior air film	0.03	
Effective R-value assembly total	**3.17**	**17.99**

	RSI	R-value
2x6 @ 16" o/c; R-22 insul	2.55	
Interior air film	0.12	
1/2 " interior gyp board	0.08	
1/2" softwood plywood or 11 mm OSB	0.109	
Rain screen cavity	0.15	
Exterior: bevel wood siding	0.14	
Exterior air film	0.03	
Effective R-value assembly total	**3.18**	**18.05**

	RSI	R-value
2x4 @ 16" o/c; R-14 insul	1.59	
Interior air film	0.12	
1/2 " interior gyp bd	0.08	
1/2" softwood plywood or 11 mm OSB	0.109	
R-10 continuous insulation	1.76	
Exterior cladding: vinyl siding	0.11	
Exterior air film	0.03	
Effective R-value assembly total	**3.80**	**21.57**

	RSI	R-value
2x8 @ 24" o/c; R-28 insul	3.48	
Interior air film	0.12	
1/2 " interior gyp board	0.08	
1/2" softwood plywood or 11 mm OSB	0.109	
Exterior cladding: stucco	0.02	
Exterior air film	0.03	
Effective R-value assembly total	**3.84**	**21.80**

	RSI	R-value
Double 2x4 @ 16" o/c with 1" space between studs; R-12 insul	2.93	
Interior air film	0.12	
1/2 " interior gyp board	0.08	
1/2" softwood plywood or 11 mm OSB	0.109	
1" continuous batt insulation	0.58	
Exterior cladding: vinyl siding	0.11	
Exterior air film	0.03	
Effective R-value assembly total	**3.96**	**22.48**
This is a double wall with the studs spaced 1" apart – total cavity width 8" with the full cavity insulated.		

	RSI	R-value
2x6 @ 16" o/c; R-20 insul; plus R-7.5 continuous exterior	3.77	
interior air film	0.12	
1/2 " interior gyp board	0.08	
1/2" softwood plywood or 11 mm OSB	0.109	
Exterior cladding: stucco	0.02	
Exterior air film	0.03	
Effective R-value assembly total	**4.13**	**23.44**

Canadian Home Builders' Association

Technical Research Committee News

BC Announces Enhanced Builder Licensing

The BC government has announced an enhanced licensing system for residential builders in the province. The enhanced licensing system applies primarily to builders constructing single-family homes and small residential buildings under Part 9 of the BC Building Code. Licensed residential builders will be classified as general contractors, developers, or both.

The changes will establish new qualifications and continuing education requirements for general contractors, as well as enhanced consumer protection provisions for all licensees. The intent is that the enhanced system will lead to higher professional standards in the residential construction sector and increased consumer protection for buyers of new homes in BC. The changes come after long work with the home building industry which supports the changes.

The new licensing system establishes new qualification requirements for licensed general contractors. In order to obtain a new licence, applicants will now be required to demonstrate proficiency in seven areas related to residential construction.

Core competencies

New licensees will be required to demonstrate proficiency in core competencies relating to residential construction through education and experience or equivalencies. Categories include:

- Building code
- Construction management and supervision
- Construction technology
- Customer service and home warranty insurance
- Financial planning and management
- Legal issues
- Business planning and management

To obtain a new licence an applicant must complete recognized training courses in each area of competency from approved organizations, or provide proof of equivalent training or experience.

Continuing Professional Development

All licensed general contractors will be required to take Continuing Professional Development courses in all core competency areas related to the residential construction industry as a condition of renewing their licence each year. Licensees will have to complete a minimum of 40 points of continuing professional development during the license term (one year).

More than 50% of the Continuing Professional Development must be in either building code, construction management and supervision, construction technology, customer service and home warranty insurance, or a combination of these four subjects.

Credit of up to 20 points will be given for on-the-job learning through active practice as a homebuilder, formal learning or informal learning. Active practice means being actively engaged in the construction management of new homes during the year. Formal learning means attendance in structured courses and training sessions (which would include an exam or assignment component) from approved organizations. Two points will be earned for every hour of formal learning.

Informal learning can include conferences, seminars, and workshops, meetings of industry associations, and participation in residential construction research and development. One point will be earned for every one hour of informal learning attended.

Existing licensed residential builders in good standing are exempted from completing the new qualifications requirement, as well as licensed developers building only under Part 3 of the BC Building Code. In addition, licensed developers building homes and smaller buildings who hire a licensed general contractor to construct the homes for them will be exempted.

The new licensing requirements will be phased in over 16 months to give licensees time to learn about the enhanced system and prepare for the new requirements.

Phase1: Continuing Professional Development takes effect September 4, 2015. Renewing licensees have until their next renewal, one year later, to achieve the required points. New licences or renewal of licences will be subject to a new consumer protection provision that allows

the registrar to refuse issuance if there has been a history of bad business practices that harms consumers.

Phase 2: Qualifications – education and experience requirements for new licence applicants take effect March 4, 2016.

Phase 3: Owner builder exam requirement takes effect July 4, 2016.

Currently, owner builders must obtain an authorization from the HPO that permits them to build a new home for their own personal use. Now, in addition to the current criteria for an Owner Builder Authorization, owner builders will be required to pass an examination on home building basics. This new requirement is meant to help owner builders expand their knowledge about home building basics, enhance the quality of residential construction and increase protection for consumers.

Illustrated User's Guide – NBC 2010 Part 9 Housing and Small Buildings

The National Research Council's Canadian Codes Centre has announced the publication of the Illustrated User's Guide – NBC 2010 Part 9 Housing and Small Buildings. This User's Guide updates earlier publications. It includes new material on energy efficiency requirements for housing and small buildings and includes updates to match the latest changes to the NBC.

The User's Guide illustrates important principles of minimum accepted practice and explains the reasons and background behind the Part 9 requirements. This is not a how-to guide on home construction, but it illustrates important principles of minimum accepted practice in one comprehensive document that describes various compliance approaches, including examples and supporting formulas. Relevant code information is cross-referenced to the code. To facilitate navigation, it is organized to match the format used in Part 9 of the National Building Code of Canada (NBC).

Building and fire officials will also benefit, as it explains the reasons and scientific background behind the Part 9 requirements.

The 641-page publication (document number NRCC 56133) is available as a soft cover book. Cost is $180.00. Purchase information can be accessed through the Canadian Codes Centre web site.

CCMC Product Evaluations

The CCMC Registry of Product Evaluations is once again available online, and has been upgraded to a PDF format, with an easy to use, searchable index. Search fields are Evaluation Number, Manufacturer, Product Name, and Product Type.

The Registry of Product Evaluations contains all Evaluation Reports and Listings on more than 500 products evaluated by the CCMC. Indexed to the MasterFormat system, it is an invaluable tool for building professionals at every stage of design and construction to check the acceptability of specified products, and their installation.

The index is publicly available, but access to the Evaluation Reports and Listings themselves, which is free, is only accessible to qualified construction and design professionals and educators, CCMC clients and stakeholders.

Previously, the CCMC Product Evaluations were readily accessible to anyone – in the days before the Internet, they were published in hard copies and were widely available, including in many public libraries. The rationale for this extra hurdle to access the reports is that "technical documents (are) intended to be used by qualified construction and design professionals and educators, CCMC clients and stakeholders, including regulators and building officials. Access is controlled on this basis, to avoid potential confusion and misuse."

It's not entirely clear what the confusion and misuse could be, and by who, that would require adding a restriction on access to information.

Alberta Building Code Update

The 2014 editions of the Alberta Building and Fire Codes based on the 2010 National Building and Fire Codes were adopted at the end of February 2015 by provincial regulation. Also adopted by regulation is the National Energy Code for Buildings (NECB) 2011 edition.

The code comes into force May 1, 2015, and with a transition period that ends November 1, 2015. The transition period allows users to use either edition of the code to prevent unnecessary and costly changes to construction already underway or plans that have been substantially completed for construction.

However, the implementation of the energy efficiency requirements (section 9.36) has been delayed. Section 9.36 comes into force May 1, 2016 with the transition period ending November 1, 2016.

Harold Orr Presented With Passive House Pioneer Award

Passive House Institute Recognizes Canada's Contribution

Harold Orr from Saskatoon was presented with a Pioneer Award at the 19th International PassivHaus conference in Leipzig Germany. Harold led the team at the National Research Council Institute for Building Research in Saskatchewan in the late 1970s. The work of Harold and his team revolutionised the cold climate home building industry, that led to Canada's leading-edge R-2000 programme which made possible all that is going on in net-zero-energy homes now.

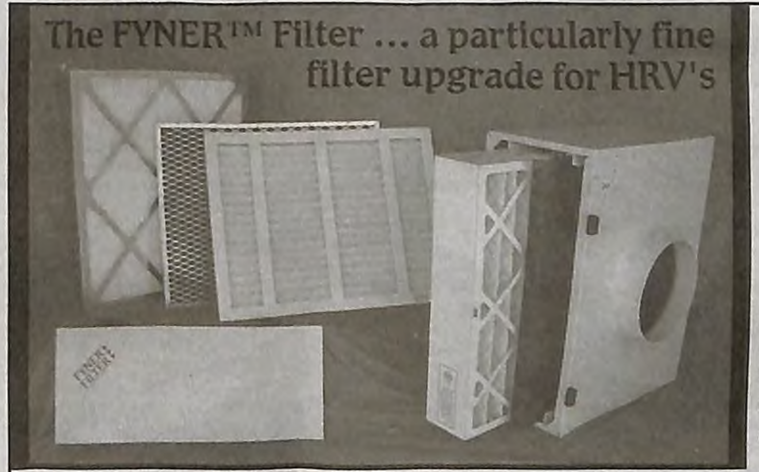
The Pioneer Award recognizes the trailblazers of energy efficient construction. This year the Saskatchewan Conservation House was recognized. It was a project where many features of the R-2000 Standard were developed and successfully tested in 1977. Harold Orr and his collaborators realised 40 years ago that efficiency is the key to sustainable construction, since energy produced in the summer cannot be readily stored for the winter.

Initially, when plans for an experimental solar building were made, the Saskatchewan government wanted a solar house that at the time meant active solar energy. It was built against the backdrop of the 1970s oil crisis.

As the team got into detailed planning, it quickly became apparent that this would not be practical because in the cold Regina climate the solar gains from November to March are too low. Instead, they opted for a well-insulated (R-40) double-wall structure, with attic at R-60 and the main floor over a crawlspace R-20. The home's airtightness was tested at 0.8 air changes, at a time when typical houses in Saskatchewan were tested at 3 to 5 air changes. Windows were triple glazed – a rarity at the time, but the best available at a time before the availability of multi-paned low-e glazing. Ventilation was also recognized as being important, and since heat recovery ventilators were not available at the time, the team built one on site (which led to the development of the VanEE HRV).

The Saskatchewan Conservation House was the start of a revolution in building in Canada and around the world. The methods used for improving the energy efficiency of houses became the inspiration not only for R-2000, but many programs in other countries including Canada's housing export intuitive (Super-E – which lost Canadian government support a few years ago), and the Passive House Standard which has become the European benchmark for high performance housing.

The success of the Saskatchewan Conservation House was made possible through the engagement of the many experts involved in the project. In addition to Harold Orr, those responsible included Dave Eyre, Dave Jennings, Deryl Thomson, Harry Filson, Hendrik Grolle, Bill Gibbons, Rob Dumont, George Green, Robert Besant, Garry Marvin, Fred Heal and others. ☼



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Energy Answers

Rob Dumont

We conclude Rob Dumont's Directives For a Decent Energy Efficient Home.
In the last three issues we presented the first 18 points. Here we present the remainder.

20. Durability. In coastal and higher rainfall areas, make sure that your walls are of a rain screen design. Don't buy the cheapest asphalt shingles for your roof. A lot of energy is required to replace short-lived building materials. If you are building in a rural area with limited or no fire protection services, use non-combustible siding and roofing materials. As an extra measure, some homeowners in rural areas purchase roll-down steel shutters to protect the windows during the fire season. Trees should be no closer than about 15 metres from the house. For more information, have a look at the Firesmart principles available at the following web site: *http://srd.alberta.ca/wildfire/firesmart/documents/Firesmart-HomeownersManuaYl-ProtectY-ourHomeFromWildfire.pdf*

To extend the life of the tank in your water heater, periodically change the anode rod, which helps to protect the steel tank from corroding. An experienced plumber told me that he had seen a tank water heater last 50 years because the anode rod was periodically replaced. Have a look at *http://www.thisoldhouse.com/toh/video/0,,20047047,00.html* to learn more about how to change the anode rod in a water heater. Install a drain pan underneath the tank to collect water leaks and run the drain into the sewer.

Directives For A Decent, Energy Efficient Home

1. Design
2. Lot Selection
3. House Shape
4. Design for flexibility
5. Trees
6. Garage Type
7. Contractors
8. Windows
9. Thermal mass
10. Insulation levels
11. Air tightness and mechanical ventilation with heat recovery
12. Low-emission materials
13. Space Heating/Cooling and Domestic Water Heating
14. Renewable Energy
15. Cooling/Air Conditioning
15. High Efficiency Lighting.
16. Efficient Water Use.
17. Energy Star Appliances
18. Safety
19. Durability
20. Think multiple uses, low impact materials

Regularly change the air filters in your furnace and heat recovery ventilator. Furnace efficiency will be severely reduced and furnace heat exchanger failures are more common when the air filters are not regularly changed.

Although not as dramatic as fire, moisture problems can make homes unliveable in a few short years. If building materials are kept dry, wooden structures can last for centuries. Europe in particular has many examples of this, including a wood stave church in Norway that dates to the 1200s.

Anecdotally, Yukon Housing's Technical Officers estimate that as many as 90% of the houses that they see have some moisture problems. Moisture problems may be the biggest issue in housing: moisture from the roof, moisture around foundations, roof water draining against foundations, poor site grading and poor foundation drainage, moisture build up in the house due to poor ventilation, condensation due to air leakage and thermal bridging, ice damming, poor siding and flashing details, plumbing leaks, high water tables, flooding, capillary rise from the soil, etc.

Plumbing leaks can be very expensive to repair. A friend in Saskatoon had a hose break on the rubber hose that connected the hot water line to the clothes washer. Murphy's law also cut in, and the hose break occurred on a weekend when the family was away. The clothes washer was on the second floor of the house, the house had hardwood floors, and no one checked on the house while the owners were away. The estimated repair costs to the ceilings and hardwood floors below the laundry room was in the $10,000 range. To reduce the chance of this happening in your house, a few things can be done:

1. Use special water hoses to the clothes washing machine that have braided stainless steel weaving on the outside to minimize the likelihood of hose breaks. The two hoses cost about $50 as of 2013.
2. Put a floor drain in the laundry room, and caulk the baseboards and door threshold to the floor to prevent water seeping into the base of the walls and into other rooms.
3. Turn the water supply to the house off when you are away and the house is unoccupied. Check your insurance policy to see how often someone must check the house when it is empty.

A good roof overhang and drainage plane behind siding can protect the façade from rain and water ingress. Eavestroughs with downspouts that drain away from the house, positive site drainage, and foundation drainage, and capillary breaks are all necessary to protect foundations and basement walls from getting wet. Do not put cast-in-place concrete sidewalks directly against the foundation wall, as soil compaction over time will cause a cavity to exist under the sidewalk. Water will accumulate in this cavity and may leak into the basement. In my house, the sidewalks adjacent to the foundation walls were made of precast 2-inch (50 mm) thick paving blocks about 24 inches (600mm) by 30 inches (750 mm) laid over a double layer of black plastic placed over soil. The soil was graded at a 1/10 slope away from the house.

Water, both small and large amounts, must be kept well away from the foundation by careful placement of the rainwater leaders and splash blocks at the base of the downspouts. Most house insurance policies do not cover surface water entry through basement windows or foundation walls. "The insurance runs out when the water runs in."

Some informed reviewers stated that the outlets from the rainwater leaders should empty at least 3 metres (10 feet) away from the foundations of houses, and a positive drainage slopes should exist to move water away from the foundation. Normally the backfill against the foundation will settle, and initial slopes as high as 1 in 4 were recommended by one reviewer.

Don't build on a flood plain unless there are dykes with a proven record of protection against flooding. Do not use flooring materials below grade that are susceptible to moisture damage.

21. Think multiple uses, low impact materials when designing.

As mentioned above, orient the roof surface for future solar devices. A roof overhang can also serve as an exterior shade for the windows on the south side.

The noted architect Frank Lloyd Wright stated that you should never put anything in a dwelling that serves only one purpose. One net zero energy house has used concrete floor toppings that provide both thermal mass and a floor surface with a polished surface. *http://greenedmonton.ca/mcnzh-finished-concrete-floors* Stamped and coloured concrete is another possible alternative.

Use water collected on the roof for irrigation. A rain barrel is an inexpensive technology. On some homes rain barrels have been interconnected in parallel to allow for greater capture of roof runoff.

In the author's home, cellulose insulation was used throughout. About 16,000 pounds (7,300 kg) of cellulose insulation was used in the house. Cellulose insulation is made from recycled newspaper with a fire retardant added. Wood based products have the advantage that they generally take less energy to produce than competing products. Wood products are about 50% carbon by weight, and this carbon is extracted from the carbon dioxide in the earth's atmosphere during photosynthesis as the trees grow, reducing this greenhouse gas. Wood generally has a lower embodied energy than steel or concrete.

The author's house used a lot of wood materials including cedar shakes on the roof, pre-finished hardboard siding with a 25-year warranty, a preserved wood foundation, and hardwood floors. In addition to the conventional wood framing materials, birch plywood frames for the kitchen cabinets and vanities, and wooden interior doors were used.

The exterior front and back steps of the house have treads made of recycled polyethylene. The treads have the advantage that the colour is integral with the material, and painting has not been required, even after 17 years of service.

The detached garage for the house was recycled from a small (500 square foot) 1920s house that was originally on the front of the lot. My building contractor estimated that we had a saving of about $5,000 by reusing the old house as a garage.

No heavy imported materials such as granite counter-tops were used in the house.

In summary, a good house design should make use of strong energy and water conservation measures, use passive solar heating, be adaptable in space use, use low impact materials for construction, and plan for the eventual use of more renewable energy devices such as photovoltaic panels and solar water heaters.

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The table summariz the energy and water savings that the author has achieved in his family's house in Saskatoon compared with conventional houses in the same location. The measured data for the Dumont Residence are for 2012, when three adults (two parents and a daughter) were in the house. During 2012 there was no contribution from solar thermal collectors or photovoltaic panels.

Third Party Certification of Energy Efficient Houses

In Canada, there are several third party certification standards that invlude energy efficiency features that substantially exceed the current minimum standards of the National Building Code. These include R-2000 and Passive House. A number of builders are now able to construct

	Conventional Houses in Saskatchewan	Dumont Residence (Built 1992) Measured 2012 data	% Reduction for Dumont Residence
Annual total purchased water consumption (cubic metres/year) (City of Saskatoon data)	306.0	140.0	54%
Annual water consumption for domestic hot water (cubic metres per year)	82.1	40.8	50%
Annual Electricity Usage for Domestic Hot water (kWh/yr) (SaskEnergy data)	4546	2254	50%
Annual Electricity Usage for lights, appliances and miscellaneous uses excluding space and water heating (kWh/year) (Statistics Canada)	8340	4086	51%
Annual Total Energy Consumption [purchased energy for space heating, water heating, lights, appliances and miscellaneous electricity per square metre of floor area] (kilowatt hours/m^2/yr)	300	56.7	81%

these homes. These third party groups incorporate some of the directives mentioned in this article.

Final thoughts: The Roman architect and engineer Vitruvius, working about 2100 years ago, wrote that buildings should be designed to be "solid, useful and beautiful". I interpret his words to mean that buildings should be durable, make good use of the local climate, and be sufficiently economical, adaptable, and attractive that people will want to maintain the buildings for a long time. These are truly admirable goals, and ones that we should all strive to incorporate in our building designs. Let's make our new houses "the way they ought to be," as Socrates recommended.

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Green Housing. Case study reports of EQuilibrium projects. *www.cmhc-schl.gc.ca*

Heating Systems for Your New Home, The Drawing Room Graphic Services Ltd. Box 86627 North Vancouver, BC V7L 4 L2 *solplan@shaw.ca*

HOT-2000 Computer Program. Available free from Natural Resources Canada. Use your web search engine to locate.


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